

AD-A223 104

OFFICE OF NAVAL RESEARCH

Grant or Contract N00014-89-J-1590

R&T Code 413m012

Technical Report No. 10

Characterization of PMDI/HOPG Interfaces by SERS  
Using a Silver Overlayer Configuration

by

W. H. Tsai and F. J. Boerio

Presented

at

13th Annual Meeting of The Adhesion Society  
Savannah, GA  
February 18-21, 1990

Department of Materials Science  
and Engineering  
University of Cincinnati  
Cincinnati, OH 45221-0012

June 1, 1990

Reproduction in whole or in part is permitted for any  
purpose of the United States Government

This document has been approved for public release and sale;  
its distribution is unlimited.

90 06 11 10



## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION None			1b. RESTRICTIVE MARKINGS None		
2a. SECURITY CLASSIFICATION AUTHORITY None			3. DISTRIBUTION/AVAILABILITY OF REPORT This document has been approved for public release and sale; its distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE None			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Report #10			7a. NAME OF MONITORING ORGANIZATION Office of Naval Research		
6a. NAME OF PERFORMING ORGANIZATION University of Cincinnati		6b. OFFICE SYMBOL (If applicable)	7b. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217		
6c. ADDRESS (City, State, and ZIP Code) Department of Materials Science Cincinnati, OH 45221-0012		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-89-J-1590			
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Office of Naval Research		8b. OFFICE SYMBOL (If applicable)	10. SOURCE OF FUNDING NUMBERS		
8c. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217		PROGRAM ELEMENT NO. N00014-89	PROJECT NO. J-1590	TASK NO. 413m012	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Characterization of PMDI/HOPG Interfaces by SERS Using a Silver Overlayer Configuration					
12. PERSONAL AUTHOR(S) W. H. Tsai and F. J. Boerio					
13a. TYPE OF REPORT Technical Report		13b. TIME COVERED FROM TO		14. DATE OF REPORT (Year, Month, Day) June 1, 1990	
15. PAGE COUNT 2					
16. SUPPLEMENTARY NOTATION Presented at 13th Annual Meeting of The Adhesion Society, Savannah, GA, Feb. 18-21, 1990.					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	PMDI/HOPG Interfaces, SERS, Silver Overlayer		
			DD FORM 1473 (10-89)		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Surface-enhanced Raman scattering (SERS) was used for characterization of model fiber/polyimide interfaces. Pyromellitic diimide (PMDI) was used as a model polyimide while highly oriented pyrolytic graphite (HOPG) was viewed as a model graphite fiber. Samples for SERS were prepared by depositing films of PMDI onto HOPG and then depositing silver island films on top of the PMDI. When the PMDI films were relatively thick (85 Å), the SERS spectra were similar to normal Raman spectra of bulk PMDI. These spectra were characterized by the imide bands near 1775, 1748, 1368, and 659 $\text{cm}^{-1}$ and by the benzene ring bands near 1633, 1200, 762, 578, and 520 $\text{cm}^{-1}$ , respectively. For thin films of PMDI (about 15 Å), the SERS spectra were considerably different from normal Raman spectra of PMDI and SERS spectra of thick PMDI films on HOPG. The 1775 $\text{cm}^{-1}$ band due to a C=O stretching vibration and the 762 $\text{cm}^{-1}$ band related to a ring breathing mode were weak while the 1368 $\text{cm}^{-1}$					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Joann Milliken			22b. TELEPHONE (Include Area Code) (202)696-4410		22c. OFFICE SYMBOL

19. Abstract (continued)

band due to a CNC axial stretching vibration and the 1200  $\text{cm}^{-1}$  band due to a CNC axial stretching vibration and the 1200  $\text{cm}^{-1}$  band due to a CX in-plane stretching mode were strong. Differences in the relative intensities of bands in the SERS spectra were attributed to orientation effects. It was concluded that PMDI films deposited on HOPG were actually bilayers in which the molecules adjacent to the surface were adsorbed with a vertical conformation in which the planes of the molecules were perpendicular to the surface and one imide group was in contact with the surface. Molecules farther away from the surface had a random orientation.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
List	Mail and/or Special
A-1 21	

DOCUMENTLESS INPUT per Dr. J. Milliken  
 ONR/Code 1114  
 TELECON 6/11/90 VG

